Commentary
Volume 9:1, 2021

Journal of Astrophysics & Aerospace Technology

ISSN: 2329-6542 Open Access

Axion as a Fuzzy Dark Matter Characteristics

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About the Study

Axion as a coherently oscillating huge scalar field is referred to act as a zero-pressure irrotational fluid with characteristic quantum stress on a small scale. In the relativistic perturbation theory, the case was most conveniently demonstrated in the axion-comoving measure up to completely non-linear and exact order. Our essential assumption that will be that the Compton frequency is more modest than the horizon scale. Here, we return to the relativistic confirmation to the direct request in the other measure conditions. The comoving measure, the zero-Shear gauge, and the uniform-curvature gauge give a similar condition for density perturbation known in the non-relativistic quantum mechanical treatment in all scales. Then again, the quantum stress term is missing in the coordinated gauge, and irregularity is found in the uniform-expansion measure. Without quantum stress, the basic density perturbation conditions of the axion in the zero-shear measure and the uniform-curvature gauge were not expected. Indeed, even in the zero-pressure fluid, the conditions in the two gauges concur with the one in the comoving measure just in the sub-horizon scale. We explain that our examination is legitimate for scales bigger than the Compton frequency, which is immaterial, contrasted and the cosmological scale. For correlation, we survey the non-relativistic quantum hydrodynamics and present the Schrodinger condition to first-arrange post-Newtonian expansion in the cosmology setting.

A coherently oscillating huge scalar field without collaboration is referred to act as a pressure less fluid. A model is an axion where its pseudo nature doesn't meddle with its cosmological role. A particularly scalar field can have a role soon after the inflation, with the field oscillating at the lower part of the potential, giving a short matter-dominated period before the radiation domination. All the more critically, it can fill in as a chilly dark matter. Calling a coherently oscillating period of the huge scalar field as axion, dismissing the mass scope of the first QCD axion, may be an overuse of the term, yet here we will keep on using it.

The huge scalar field, indeed, has characteristic stress with quantum origin. The quantum origin is evident in the non-relativistic treatment dependent on the fluid formulation of the Schrodinger condition referred to as early as in 1926, that very year both the Schrodinger condition and its relativistic variant, the Klein-Gordon condition, appeared; for a historical summary. We audit the non-relativistic treatment. The quantum stress term with extreme light mass has as of late pulled in much consideration as the fuzzy dark matter empowering to determine the limited scale strains experienced in the ordinary cold dark matter situation while partaking in all the accomplishment of the cold dark matter for an enormous scope; for a new audit. The relativistic cosmological perturbation theory depends on Einstein's situation along with the Klein-Gordon condition in the homogeneous and isotropic cosmological foundation. The relativistic treatment relies upon the gauge decision, particularly the temporal one frequently called the hypersurface or slicing condition; the spatial measure condition is trivial and unique in the homogeneous and isotropic foundation. Previous analysis utilized the zero-shear gauge, the coordinated measure, the uniform-shape gauge, and the commoving measure. However, the density perturbation condition has showed up just in the comoving gauge.

How to cite this article: Emeru, Girma Mulugeta. "Axion as a Fuzzy Dark Matter Characteristics." *J Astrophys Aerospace Technol* 9 (2021) : 169.

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Received: September 02, 2021; **Accepted**: September 16, 2021; **Published**: September 23, 2021